US009213689B2

(12) **United States Patent**
Bobick et al.

(10) **Patent No.: US 9,213,689 B2**
(45) **Date of Patent: *Dec. 15, 2015**

(54) **TECHNIQUES FOR CREATING COMPUTER GENERATED NOTES**

(75) Inventors: **Mark Bobick**, Indialantic, FL (US); **Carl Wimmer**, Christ Church (BB)

(73) Assignee: **MAKE SENCE, INC.**, Road Town (VG)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1135 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/225,638**

(22) Filed: **Sep. 6, 2011**

(65) **Prior Publication Data**

US 2012/0004905 A1 Jan. 5, 2012

Related U.S. Application Data

(63) Continuation of application No. 11/761,839, filed on Jun. 12, 2007, now Pat. No. 8,024,653, and a

(Continued)

(51) **Int. Cl.**
G06F 17/00 (2006.01)
G06F 17/27 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G06F 17/2745*** (2013.01); ***G06F 17/27*** (2013.01); ***G06F 17/2795*** (2013.01); ***G06F 17/30864*** (2013.01); ***G06N 5/022*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 17/27; G06F 17/2785
USPC 715/200, 230, 231, 255, 256, 259
See application file for complete search history.

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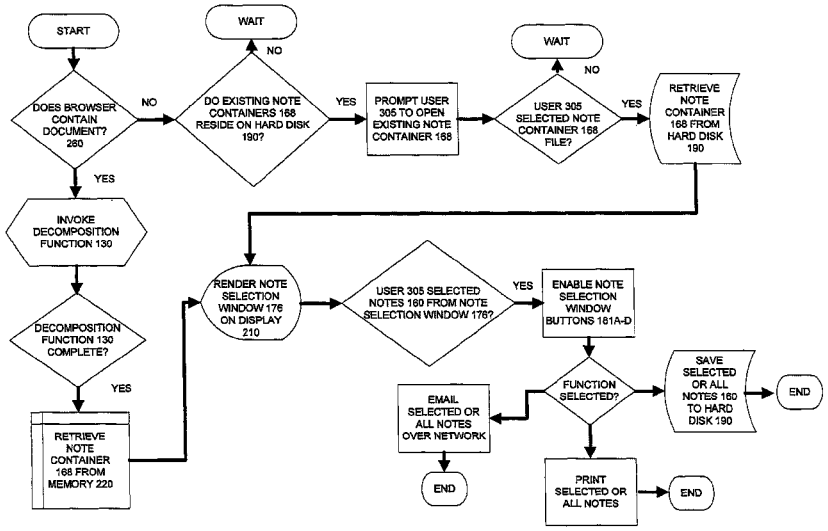
(Continued)

Primary Examiner — Stephen Hong
Assistant Examiner — Gregory J Vaughn
(74) *Attorney, Agent, or Firm* — Allen, Dyer, Doppelt, Milbrath & Gilchrist, P.A.

(57) **ABSTRACT**

Text is extracted from and information resource such as documents, emails, relational database tables and other digitized information sources. The extracted text is processed using a decomposition function to create. Nodes are a particular data structure that stores elemental units of information. The nodes can convey meaning because they relate a subject term or phrase to an attribute term or phrase. Removed from the node data structure, the node contents are or can become a text fragment which conveys meaning, i.e., a note. The notes generated from each digital resource are associated with the digital resource from which they are captured. The notes are then stored, organized and presented in several ways which facilitate knowledge acquisition and utilization by a user.

18 Claims, 10 Drawing Sheets



Related U.S. Application Data

continuation-in-part of application No. 11/273,568, filed on Nov. 14, 2005, now Pat. No. 8,108,389, and a continuation-in-part of application No. 11/314,835, filed on Dec. 21, 2005, now Pat. No. 8,126,890.

(60) Provisional application No. 60/804,495, filed on Jun. 12, 2006.

(51) **Int. Cl.**
G06F 17/30 (2006.01)
G06N 5/02 (2006.01)

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FIGURE 1

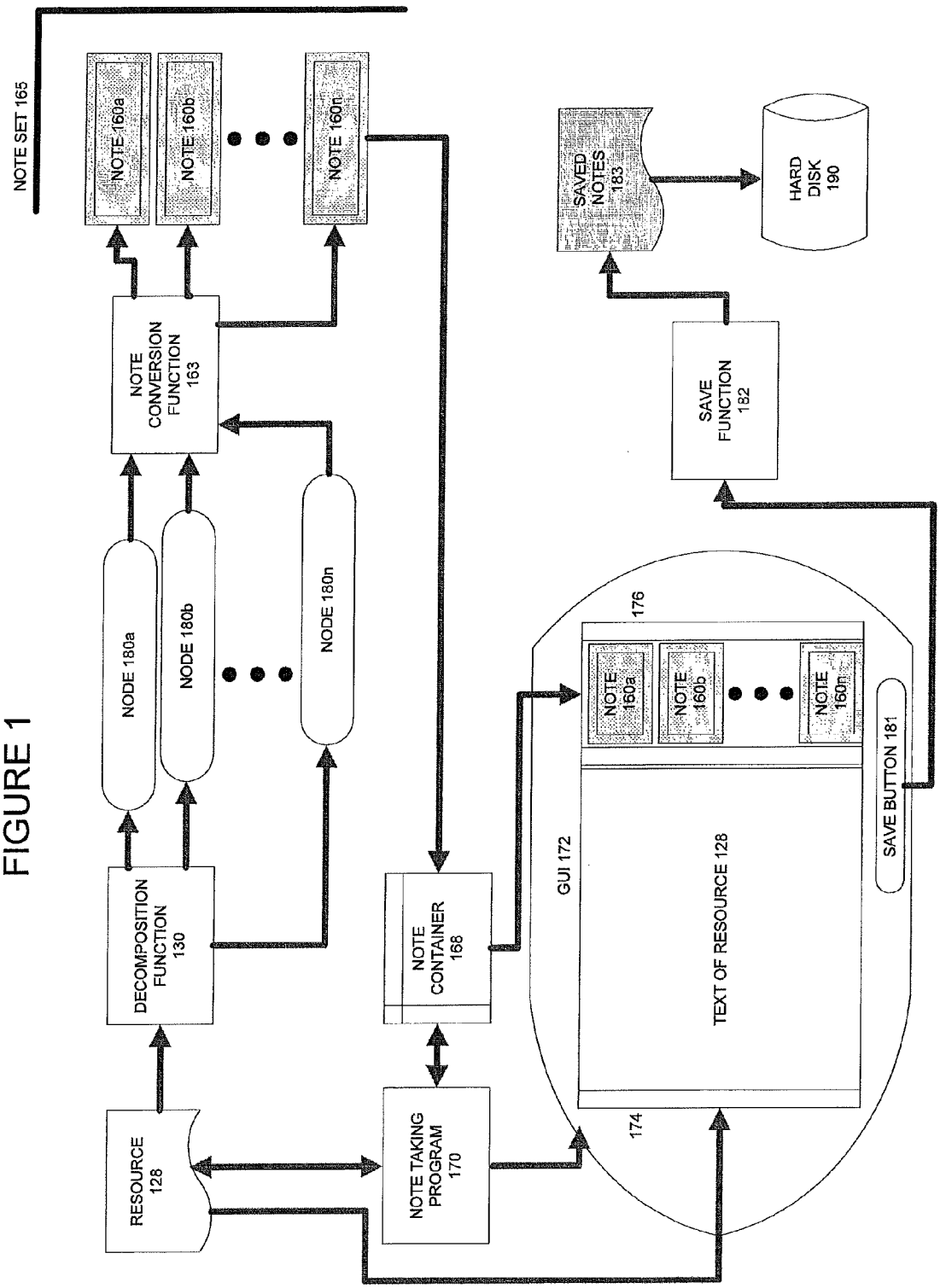

NOTE SET 165
NOTE 160a
NOTE 160b
NOTE 160n
NOTE CONVERSION FUNCTION 163
NODE 180a
NODE 180b
NODE 180n
DECOMPOSITION FUNCTION 130
RESOURCE 128
NOTE TAKING PROGRAM 170
NOTE CONTAINER 168
SAVED NOTES 183
HARD DISK 190
SAVE FUNCTION 182
176
NOTE 160a
NOTE 160b
NOTE 160n
GUI 172
TEXT OF RESOURCE 128
SAVE BUTTON 181
174

FIGURE 2

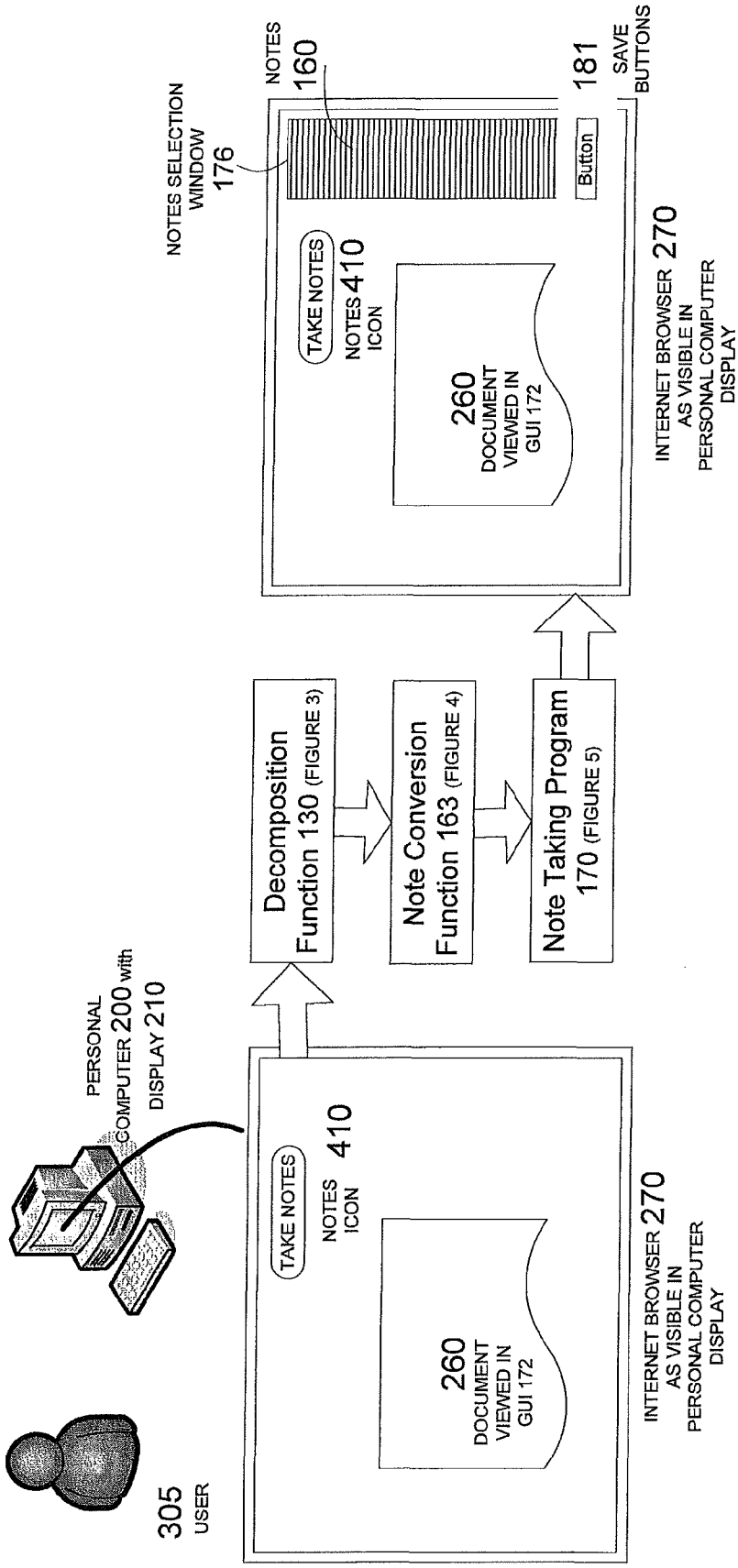

305 USER
PERSONAL COMPUTER 200 with DISPLAY 210
Decomposition Function 130 (FIGURE 3)
Note Conversion Function 163 (FIGURE 4)
Note Taking Program 170 (FIGURE 5)
TAKE NOTES
NOTES ICON 410
260 DOCUMENT VIEWED IN GUI 172
INTERNET BROWSER 270 AS VISIBLE IN PERSONAL COMPUTER DISPLAY
NOTES SELECTION WINDOW 176
NOTES 160
SAVE BUTTONS 181
Button

FIGURE 3

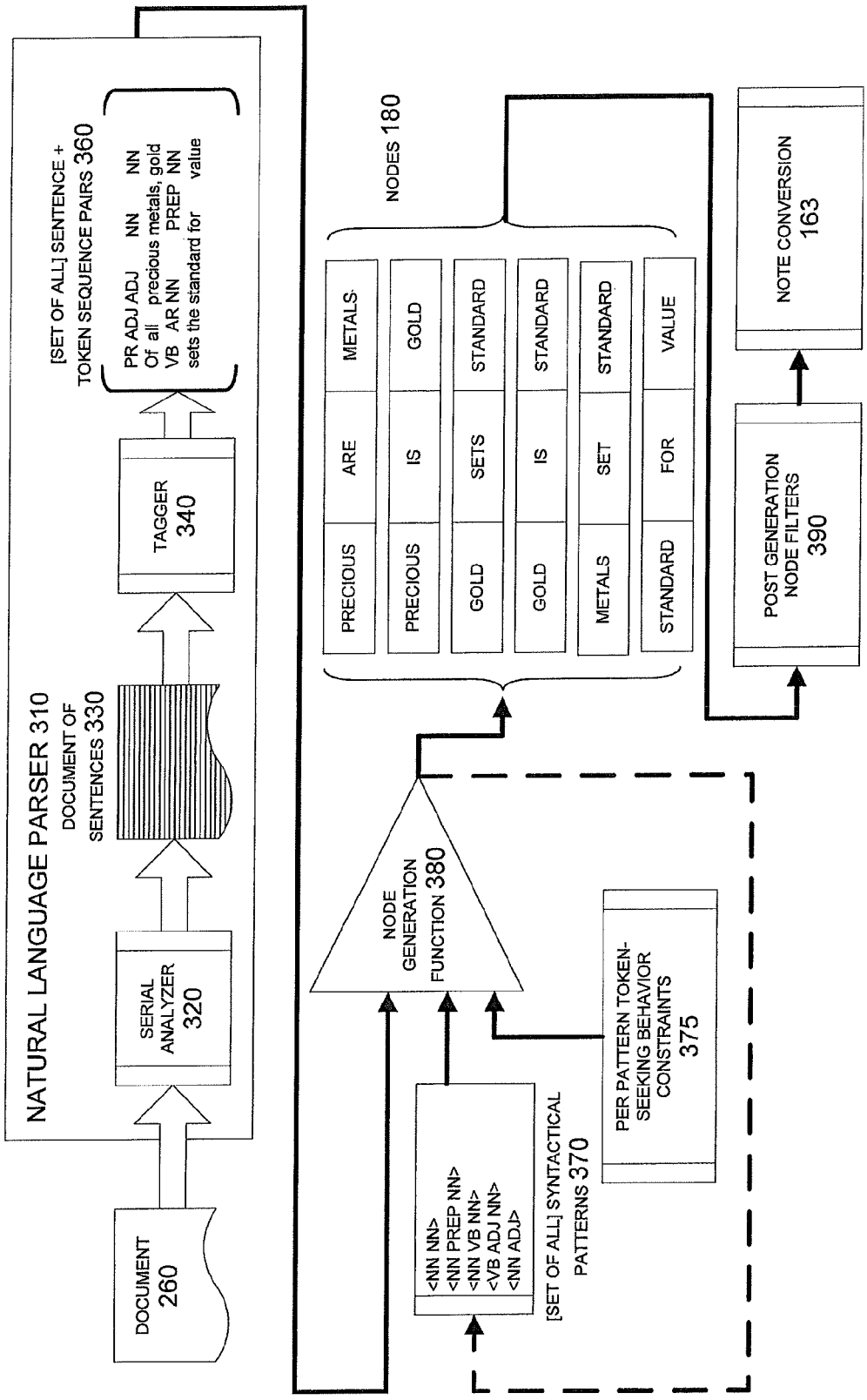

DOCUMENT 260
NATURAL LANGUAGE PARSER 310
SERIAL ANALYZER 320
DOCUMENT OF SENTENCES 330
TAGGER 340
[SET OF ALL] SENTENCE + TOKEN SEQUENCE PAIRS 360
PR ADJ ADJ NN NN
Of all precious metals, gold
VB AR NN PREP NN
sets the standard for value
NODES 180
PRECIOUS ARE METALS
PRECIOUS IS GOLD
GOLD SETS STANDARD
GOLD IS STANDARD
METALS SET STANDARD
STANDARD FOR VALUE
NOTE CONVERSION 163
POST GENERATION NODE FILTERS 390
NODE GENERATION FUNCTION 380
PER PATTERN TOKEN-SEEKING BEHAVIOR CONSTRAINTS 375
[SET OF ALL] SYNTACTICAL PATTERNS 370
<NN NN>
<NN PREP NN>
<NN VB NN>
<VB ADJ NN>
<NN ADJ>

FIGURE 4

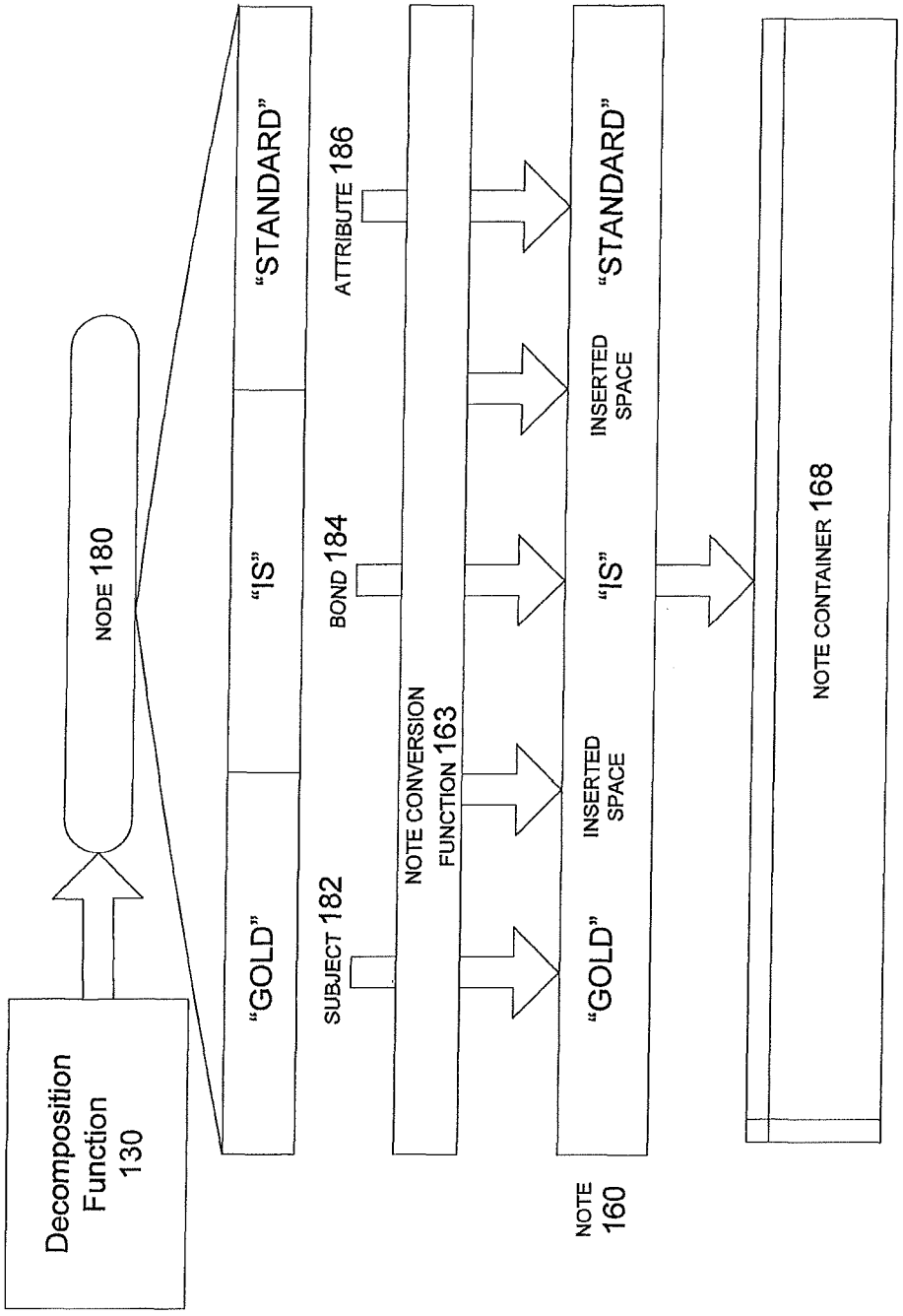

Decomposition Function 130
NODE 180
"GOLD"
"IS"
"STANDARD"
SUBJECT 182
BOND 184
ATTRIBUTE 186
NOTE CONVERSION FUNCTION 163
"GOLD"
INSERTED SPACE
"IS"
INSERTED SPACE
"STANDARD"
NOTE 160
NOTE CONTAINER 168

FIGURE 5

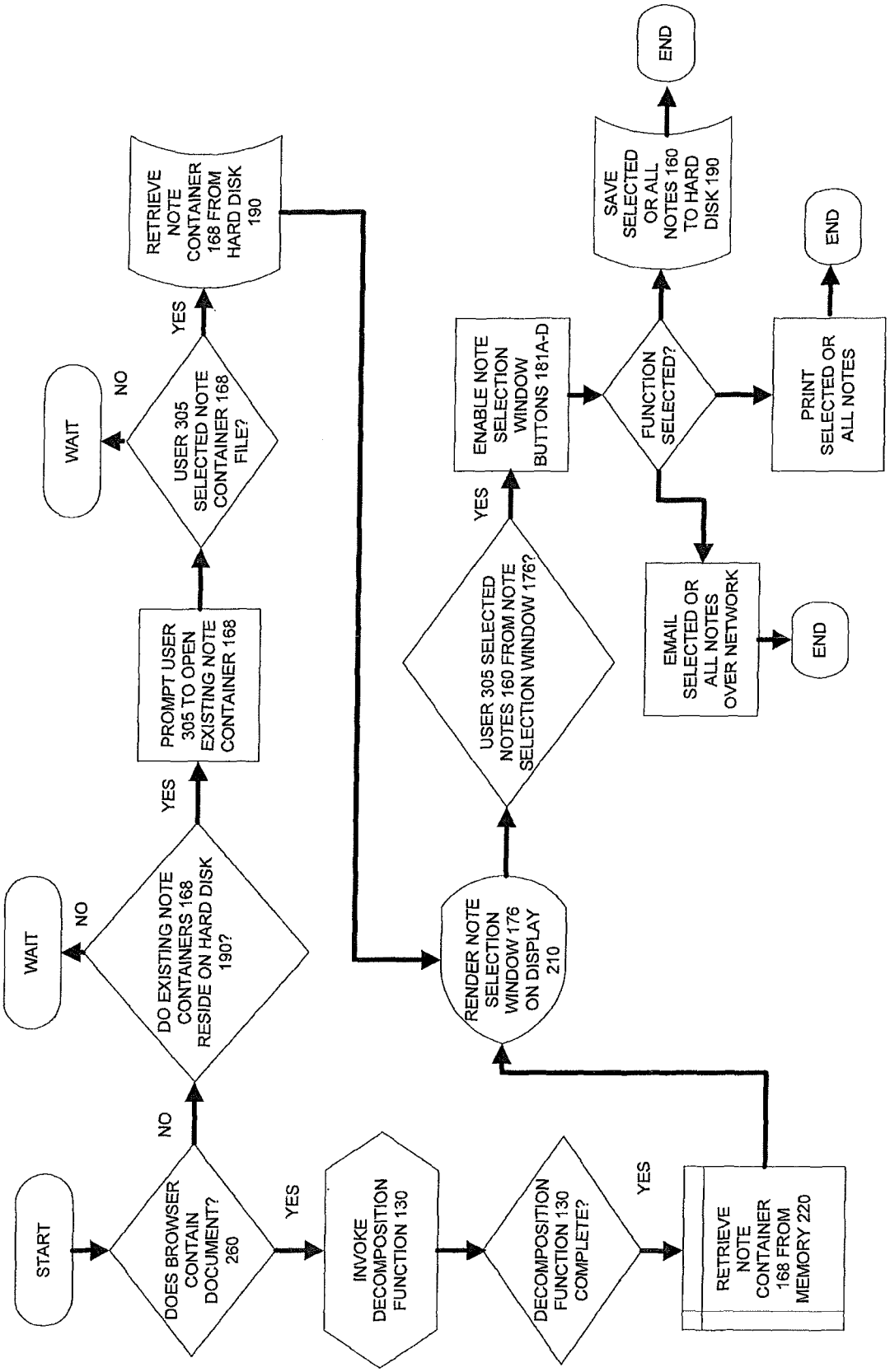
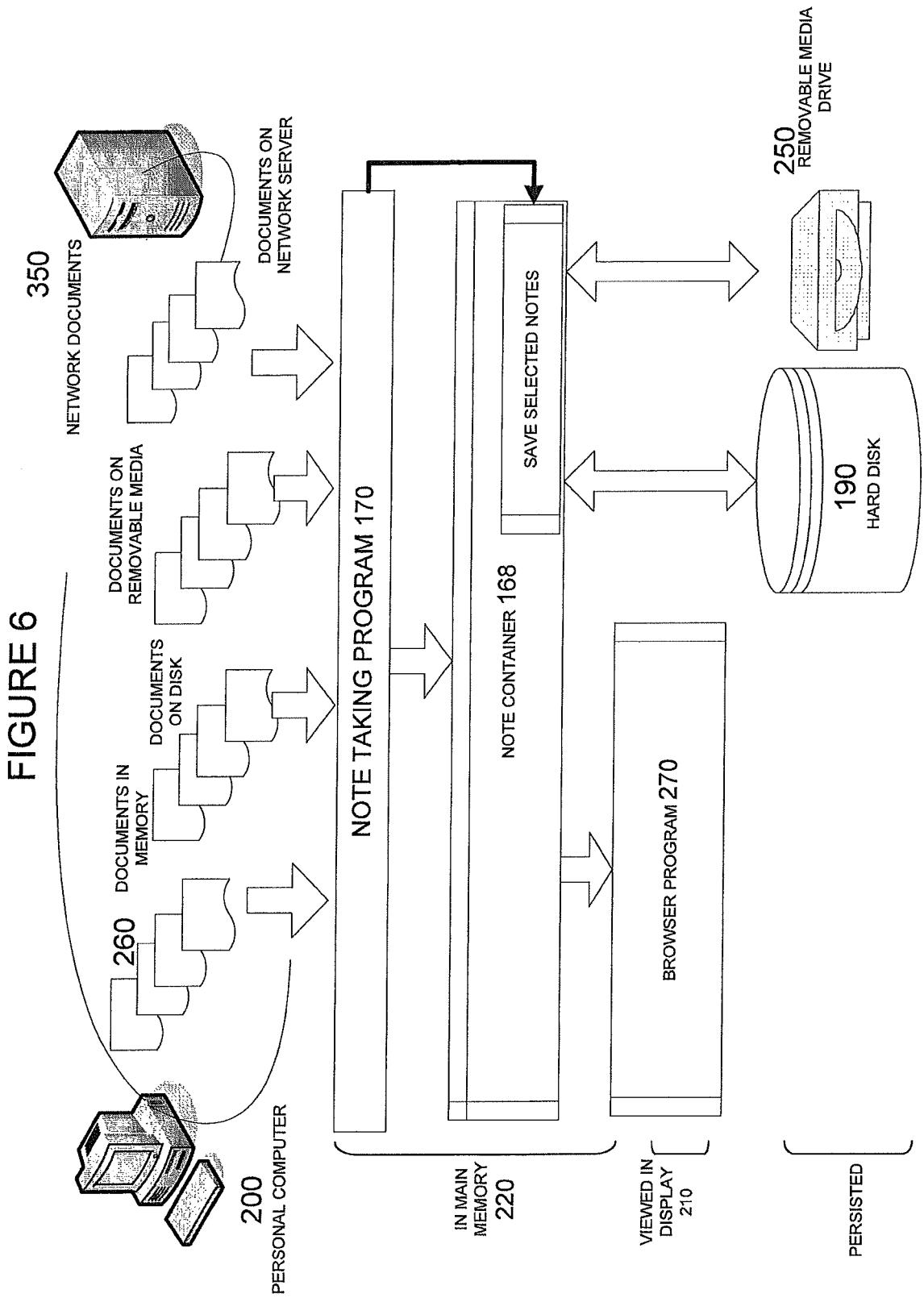

START
DOES BROWSER CONTAIN DOCUMENT? 260
NO
YES
INVOKE DECOMPOSITION FUNCTION 130
DECOMPOSITION FUNCTION 130 COMPLETE?
YES
RETRIEVE NOTE CONTAINER 168 FROM MEMORY 220
RENDER NOTE SELECTION WINDOW 176 ON DISPLAY 210
USER 305 SELECTED NOTES 160 FROM NOTE SELECTION WINDOW 176?
YES
ENABLE NOTE SELECTION WINDOW BUTTONS 181A-D
FUNCTION SELECTED?
SAVE SELECTED OR ALL NOTES 160 TO HARD DISK 190
END
PRINT SELECTED OR ALL NOTES
END
EMAIL SELECTED OR ALL NOTES OVER NETWORK
END
DO EXISTING NOTE CONTAINERS 168 RESIDE ON HARD DISK 190?
NO
WAIT
YES
PROMPT USER 305 TO OPEN EXISTING NOTE CONTAINER 168
USER 305 SELECTED NOTE CONTAINER 168 FILE?
NO
WAIT
YES
RETRIEVE NOTE CONTAINER 168 FROM HARD DISK 190

FIGURE 6


350
NETWORK DOCUMENTS
DOCUMENTS ON NETWORK SERVER
DOCUMENTS ON REMOVABLE MEDIA
DOCUMENTS ON DISK
DOCUMENTS IN MEMORY
260
200
PERSONAL COMPUTER
NOTE TAKING PROGRAM 170
NOTE CONTAINER 168
SAVE SELECTED NOTES
BROWSER PROGRAM 270
250
REMOVABLE MEDIA DRIVE
190
HARD DISK
IN MAIN MEMORY 220
VIEWED IN DISPLAY 210
PERSISTED

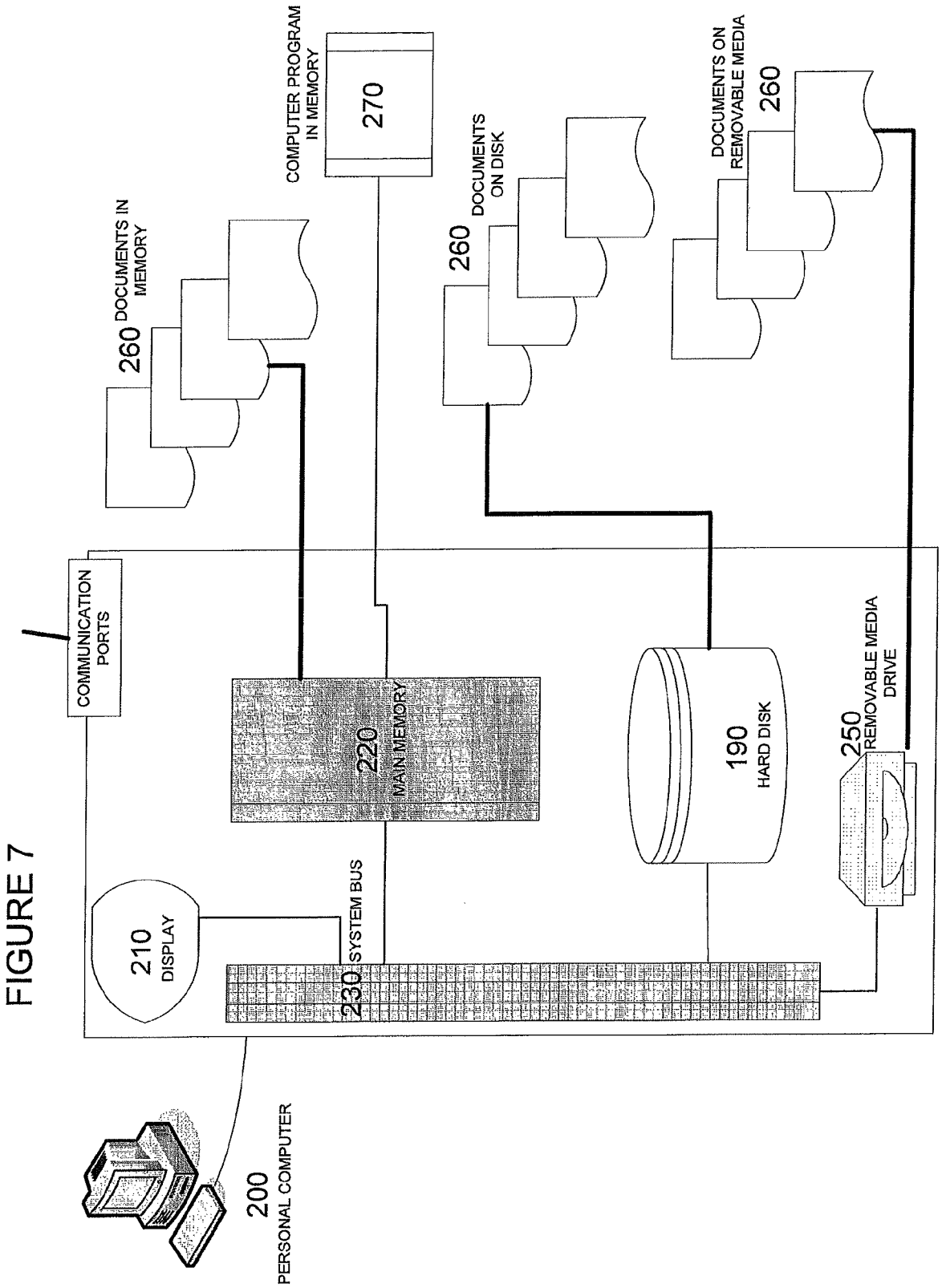

COMPUTER PROGRAM IN MEMORY
270
DOCUMENTS ON REMOVABLE MEDIA
260
DOCUMENTS ON DISK
260
DOCUMENTS IN MEMORY
260
COMMUNICATION PORTS
220 MAIN MEMORY
190 HARD DISK
250 REMOVABLE MEDIA DRIVE
210 DISPLAY
230 SYSTEM BUS
200 PERSONAL COMPUTER

FIGURE 7

FIGURE 8

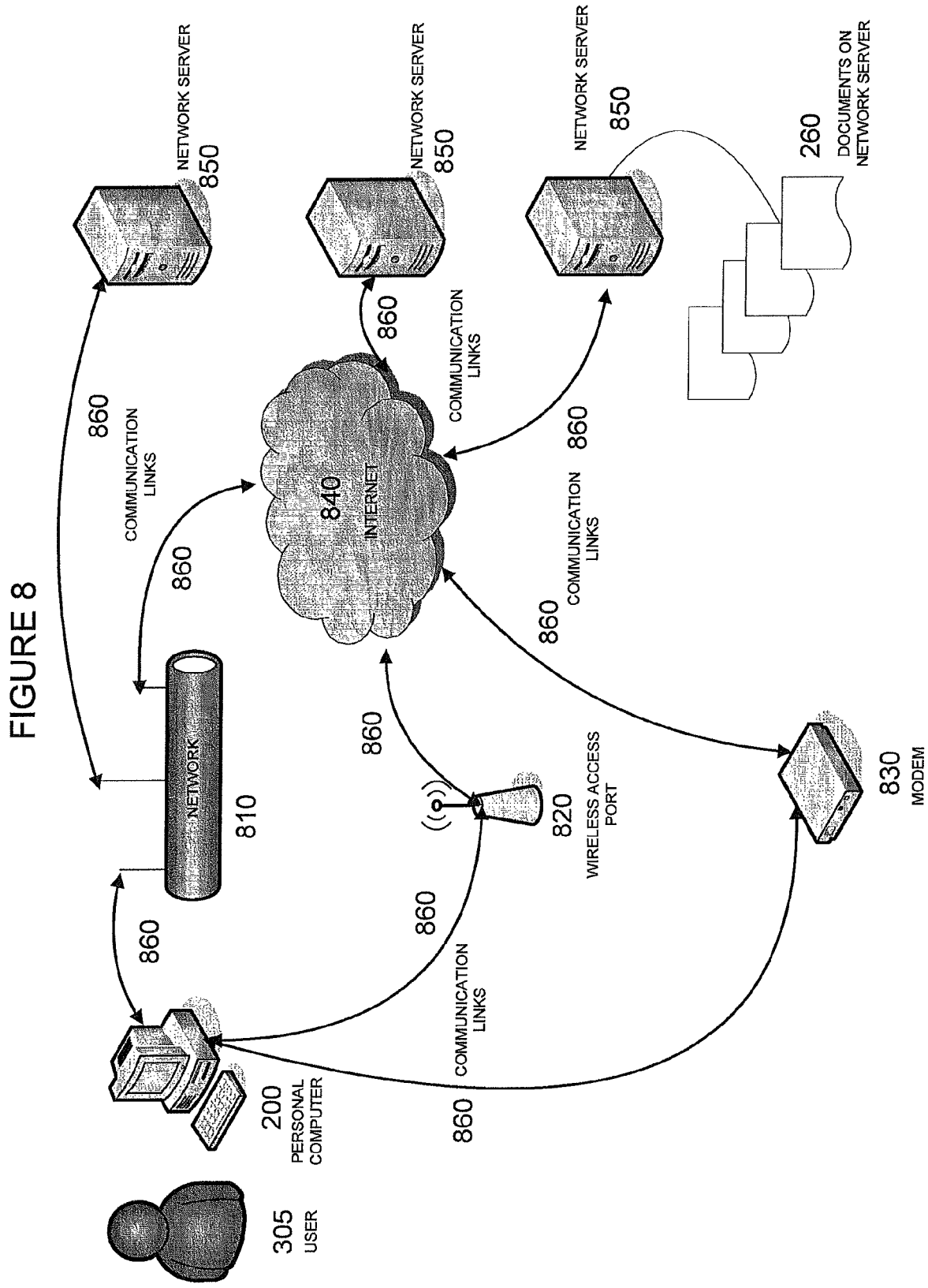

NETWORK SERVER
850
NETWORK SERVER
850
NETWORK SERVER
850
260
DOCUMENTS ON NETWORK SERVER
860
COMMUNICATION LINKS
860
COMMUNICATION LINKS
860
COMMUNICATION LINKS
860
COMMUNICATION LINKS
840
INTERNET
NETWORK
810
820
WIRELESS ACCESS PORT
830
MODEM
200
PERSONAL COMPUTER
305
USER

FIGURE 9

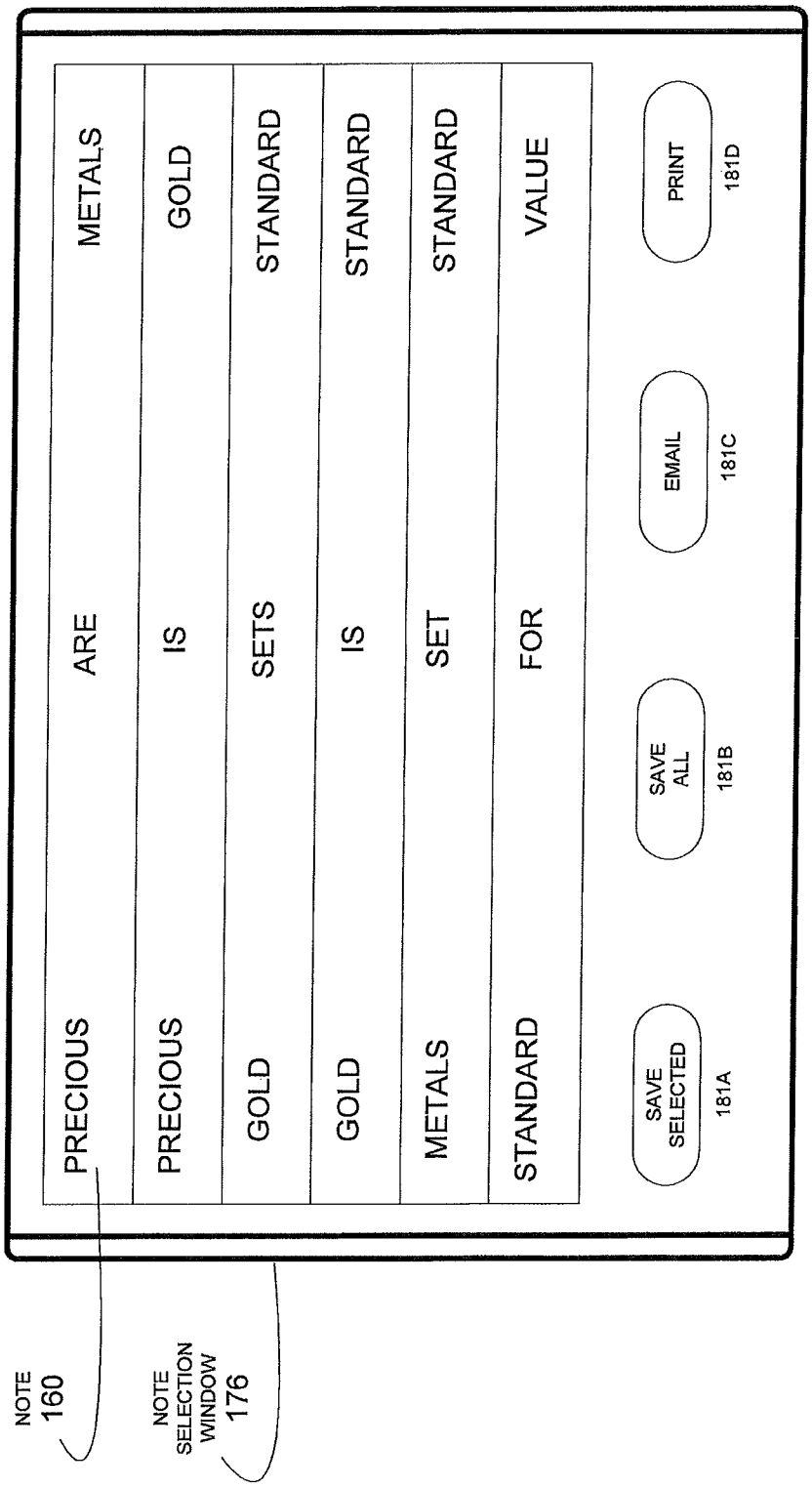

PRECIOUS ARE METALS
PRECIOUS IS GOLD
GOLD SETS STANDARD
GOLD IS STANDARD
METALS SET STANDARD
STANDARD FOR VALUE
SAVE SELECTED
181A
SAVE ALL
181B
EMAIL
181C
PRINT
181D
NOTE
160
NOTE SELECTION WINDOW
176

FIGURE 10A

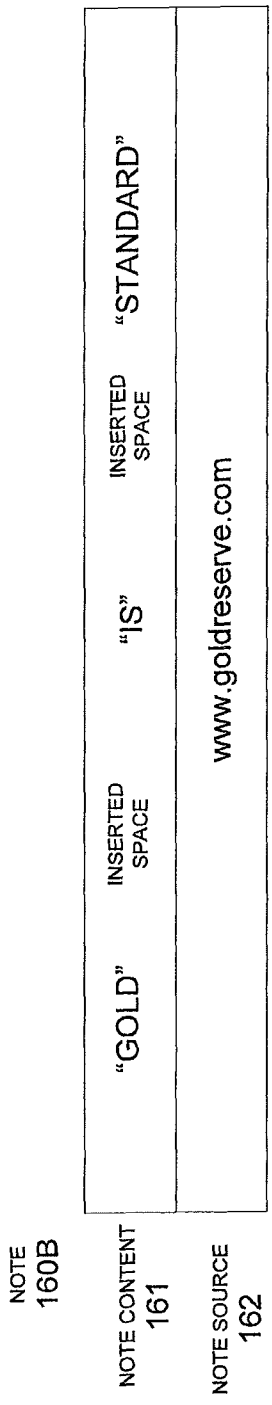
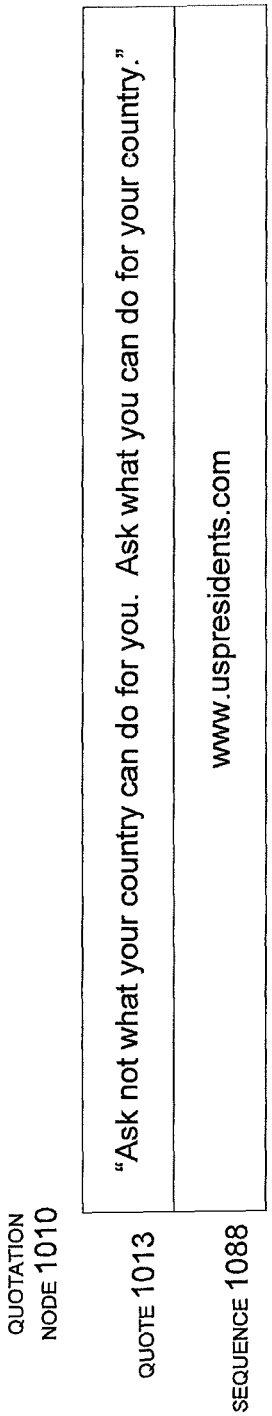


FIGURE 10B



TECHNIQUES FOR CREATING COMPUTER GENERATED NOTES

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of pending Ser. No. 11/761,839 filed Jun. 12, 2007, now U.S. Pat. No. 8,024,653 which claims priority to provisional application Ser. No. 60/804,495, filed Jun. 12, 2006, and is also a continuation-in-part of and claims priority to both (1) U.S. Ser. No. 11/273,568, filed Nov. 14, 2005 now U.S. Pat. No. 8,108,389 , and (2) U.S. Ser. No. 11/314,835, filed Dec. 21, 2005, now U.S. Pat. No. 8,126,890the contents of which are hereby incorporated into this application by reference in their entireties.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention is related to information technology and, more particularly, to the use of computer generated notes to improve comprehension and utilization of digitized information.

2. Description of Related Art

Note taking is a basic function of human knowledge acquisition from printed or digitized information sources, familiar to every student, professional, or worker who must select words or phrases of interest from a page or a document. Like the manual process of note taking, computer-facilitated or computer-automated implementations of note taking—including the current invention—all produce value to a user by distillation and/or reduction of the original text of a document into a form more readily managed by a user. The user may perform or seek the reduction and/or distillation of a page or document for the purposes of review and study—or for the purpose of correlating the resulting notes together to produce facts, assertions and conclusions. While notes generated by a human note taker may sometimes be phrases, sentences or paragraphs captured or paraphrased specifically to be quoted elsewhere, manual note taking for the purpose of knowledge acquisition typically aims to capture from a page or document some fragments which convey meaning—the fragments having a significance subjectively determined by a user. Alternatively, the user may seek only a more or less minimal description of what the document or page "is about". A number of software program products have been developed over time to assist and facilitate the note taking function.

Manual note taking for the purpose of creating and publishing study guides is familiar to every student. In the United States, Cliffs Notes (a product of Wiley Publishing, Inc.) are fixtures of secondary school homework regimes.

Document summarization is related to note taking in that the summarization function attempts to distill the contents of a page or document into a paraphrased form which is ideally of the minimum word length while including the maximum of the page or document's relevant content. Academic and commercial attention to page and document summarization has increased over recent years, especially as part of the effort to improve internet search. Text summarization is difficult, computationally expensive, and requires extremely sophisticated algorithms operating upon extensive supporting semantic, lexical and database infrastructure. Because of these factors, true text summarization is not yet considered practical. "Extractor" (a product of DBI Technologies, Inc. of Canada) illustrates the current limitations of the technology.

Many so-called note taking software products currently available are used as a simple means to capture, store, and organize the text fragment notes generated by the user while reviewing documents, web pages, or other material—either digitized or printed. An example is MagicNotes (a product of Rose City Software, Inc.). Other products capture some or all of digitized source page or document, but require the user to edit out any unwanted material. An example is Zoot (a product of Zoot Software, Inc.). In this group of software products that capture, store and organize user generated or user edited notes, the most sophisticated is Questia, (a product of Questia Media America, Inc.). Questia is an online research and library service with an extensive user interface that presents each page of a user selected digitized reference (such as a digitized encyclopedia) to the user. The user can then highlight and capture as a note any text fragment, phrase, paragraph or larger text fragment and store that fragment in an online project folder, preserving the location from which the fragment was copied. Questia then supports composition of research papers by allowing the easy pasting of the captured text fragments into a document, and then automatically generating and placing correctly formed bibliographic references.

The present invention automatically generates notes from a page or document—or from any other digitized information source. None of the currently available products is able to do so. Further, as described more hereinafter, the novel features and uses of the present invention optimize the utility of the generated notes.

BRIEF SUMMARY OF THE INVENTION

The present invention discloses a method and apparatus for utilizing the nodes generated by the decomposition function described more hereinafter and in said Ser. No. 11/273,568 as notes. A decomposition function creates nodes from documents, emails, relational database tables and other digitized information sources. Nodes are a particular data structure that stores elemental units of information. The nodes can convey meaning because they relate a subject term or phrase to an attribute term or phrase. Removed from the node data structure, the node contents take the form of a text fragment which conveys meaning, i.e., a note. The notes generated from each digital resource are associated with the digital resource from which they are captured. The notes are then stored, organized and presented in several ways which facilitate knowledge acquisition and utilization by a user.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a functional diagram of a computer generated note taking system in accordance with one aspect of the invention.

FIG. **2** is a high-level diagram showing how a user interacts with the system for computer generation of notes in accordance with one aspect of the invention.

FIG. **3** is a block diagram showing the decomposition function of FIG. **1** in accordance with one aspect of the invention.

FIG. **4** illustrates that operation of the node to note conversion function of FIG. **1** in accordance with one aspect of the invention.

FIG. **5** is a flow chart of the note-taking program in accordance with one aspect of the invention.

FIG. **6** illustrates a software architecture preferably used for the computer generation of notes.

FIG. **7** is a block diagram of a hardware architecture of an exemplary personal computer used in carrying out the invention.

FIG. **8** is a block diagram showing use of the note taking functionality in a network environment.

FIG. **9** is an illustration of an exemplary screen view of a note selection window and related control buttons in accordance with one aspect of the invention.

FIG. **10**A illustrates the contents of a note created from a four-part node in accordance with one aspect of the invention.

FIG. **10**B illustrates the contents of a quotation node in accordance with one aspect of the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** is a flow chart of the process by which the nodes generated by the decomposition function described in said Ser. No. 11/273,568 are converted into notes and then stored, organized, and presented to the user in accordance with one preferred embodiment of the invention. A digital resource **128** is input to a decomposition function **130**, generating nodes **180***a*-**180***n* as described hereinafter and in said Ser. No. 11/273,568 and said Ser. No. 11/314,835. The nodes are self contained and require nothing else to convey meaning. Referring once again to FIG. **1**, the contents of each generated node **180** is extracted and converted into a note **160** by a note conversion function **163**. A note **160** is a text object. All notes **160***a*-**160***n* generated from the same digital resource **128** or discrete part thereof are together referred to as a note set **165**. The note set **165** is placed in a note container **168**, which is a data structure suitable for storing notes **160***a*-**160***n* and associating a note set **165** with the digital resource **128** from which the notes **160***a*-**160***n* were generated.

When the note set **165** is complete all notes **160***a*-**160***n* are placed into the note container **168** by the note conversion function **163**.

FIG. **2** is a high-level diagram showing how a user interacts with the system for computer generation of notes in accordance with one aspect of the invention. In FIG. **2**, user **305** utilities a personal computer **200** with a display **210** to view a graphical user interface (**172** of FIG. **1**) which displays the text of the resource **128** in a document window **260**. The document window **260** is displayed on the display **210** in a window **270** for viewing using, e.g., an Internet browser. On the browser screen, in addition to the document **260**, there is a "take notes" button **410** preferably in the shape of a notes icon. When the user selects or otherwise activates the notes icon, the text of the resource **128** is extracted and passed to a decomposition function **130** which is shown more in detail in conjunction with FIG. **3**. The decomposition function then passes the output, described hereinafter, to a note conversion function **163**, more particularly described in conjunction with FIG. **4**.

A note taking program **170** then receives the output of the note conversion function **163** and displays the document **260** in the window together with a notes selection window **176** containing notes **160** and with one or more save notes buttons **181**.

FIG. **3** is a block diagram showing the decomposition function of FIG. **1** in accordance with one aspect of the invention. The diagram is a somewhat simplified illustration of the document decomposition Function **130**. A Document **260** is first subjected to processing by specific components of a Natural Language Parser **310**. Although there a number of Natural Language Parsers **310** available, and all available Natural Language Parsers **310** have widely differing implementations, one well known example is part of the GATE Natural Language Processor. GATE stands for "General Architecture for Text Engineering" and is a project of the University of Sheffield in the United Kingdom. GATE has a very large number of components, most of which have no bearing upon the present invention. One embodiment of the current invention utilizes a small subset of GATE components—a Serial Analyzer (called the "ANNIE Serial Analyzer") **320**, a Document of Sentences **330**, a Tagger (called the "Hepple Tagger") **340**—to extract Sentence+Token Sequence Pairs **360**. It is the Sentence+Token Sequence Pairs **360** that are utilized by the Document Decomposition Function **130**.

The set of Sentence+ Token Sequence Pairs **360** are produced in GATE as follows: The Serial Analyzer **320** extracts "Sentences"from an input Document **260**. The "Sentences" do not need to conform to actual sentences in an input text, but often do. The sentences are "aligned" in a stack termed a Document of Sentences **330**. Each Sentence in the Document of Sentences **330** is then run through the Tagger **340** which assigns to each word in the Sentence a part of speech token. The parts of speech are for the most part the same parts of speech well known to school children, although among Taggers **340**, there is no standard for designating tokens. In the Hepple Tagger, a singular Noun is assigned the token "NN", an adjective is assigned the token "JJ", an adverb is assigned the token "RB" and so on. Sometimes, additional parts of speech are created for the benefit of downstream uses. In the described embodiment, the Hepple Tagger **340** created part of speech "TO" is an example. The part of speech tokens are maintained in a token sequence which is checked for one-to-one correspondence with the actual words of the sentence upon which the token sequence is based. The Sentence+ Token Sequence Pair **360** is then presented to the Node Generation Function **380**.

A significant element of the present invention are novel Patterns of Tokens ("Patterns") **370** and Per-Pattern Token Seeking Behavior Constraints ("Constraints") **375** which are applied to the Sentence+Token Sequence Pair **360** within the Node Generation Function **380** to produce Nodes **180**, where such Nodes **180** are specifically intended to be converted into Notes **160**, where said Notes **160** conform—with specific exceptions—to notes composed by hand and ad hoc by a human reviewer of the underlying Document **260**, and where the set of said Notes **160** represents—with specific exceptions—an exhaustive extraction of all knowledge from said Document **260**.

There are several uses for part of speech patterns and token seeking rules documented in the literature of Information Extraction, the domain with which the current invention is associated, and in the related field of Information Retrieval. Text analysis for the purpose of automated document classification or indexing for search engine-based retrieval is a primary use of part of speech patterns. Part of speech patterns and token seeking rules are used in text analysis to discover keywords, phrases, clauses, sentences, paragraphs, concepts and topics. Although the meanings of keyword, clause, sentence, and paragraph conform to the common understanding of the terms, the meanings of phrase, concept, and topic varies by implementation. Sometimes, the word phrase is defined using its traditional meaning in grammar. In this use, types of phrases include Prepositional Phrases (PP), Noun Phrases (NP), Verb Phrases (VP), Adjective Phrases, and Adverbial Phrases. For other implementations, the word phrase may be defined as any proper name (for example "New York City"). Most definitions require that a phrase contain multiple words, although at least one definition permits even a single word to be considered a phrase. Some search engine implementations utilize a lexicon (a pre-canned list) of phrases. The WordNet Lexical Database is a common source of phrases. The Notes **160** generated by the preset invention can not be classified as

keywords, phrases, clauses, or sentences (or any larger text unit) using the well known definitions of these terms, except by serendipitous execution of the described functions.

The word concept generally refers to one of two constructs. The first construct is concept as a cluster of related words, similar to a thesaurus, associated with a keyword. In a number of implementations, this cluster is made available to a user—via a Graphic User Interface (GUI) for correction and customization. The user can tailor the cluster of words until the resulting concept is most representative of the user's understanding and intent. The second construct is concept as a localized semantic net of related words around a keyword. Here, a local or public ontology and taxonomy is consulted to create a semantic net around the keyword. Some implementations of concept include images and other non-text elements. Topics in general practice need to be identified or "detected" from a applying a specific set of operations against a body of text. Different methodologies for identification and/or detection of topics have been described in the literature. The Notes **160** generated by the current invention can not be classified as concepts or topics using the well know definitions of these terms, except by serendipitous execution of the described functions.

In the prior art, necessary use of part of speech pattern examination is applied within the boundaries of an individual text (intralinguistic), to resolve endophoric ambiguity. For example, in the text, "I had a professor who always carried an umbrella. He never opened it even when it rained.", the second sentence is endophora because it refers to something (the professor) who was mentioned earlier in the text but is not clearly named in the second sentence. Likewise, one "it" in the second sentence refers to "umbrella" in the first sentence. For those applications which require determining what a document "is about", such use of part of speech patterns is critical. A token seeking rule which might be applied in this case—when processing the second sentence—might be to "go back" to find the noun in the first sentence to which the "He" (or the "it") in the second sentence applies. The Constraints **375** described herein do not mirror the token seeking rules present in the prior art except in the most abstract of characteristics. The Constraints **375** can not be used to identify keywords, phrases, clauses, sentences, concepts or topics. The Patterns **370** crafted for the present invention can not be used to identify keywords, phrases, clauses, sentences, concepts or topics in the formally accepted structures of instantiations of those terms. Further, the Patterns **370** and Constraints **375** required for the current invention differ from those required for Ser. No. 11/273,568 and Ser. No. 11/314,835. The fundamental difference is that the Pattern **370** and Constraints **375** are designed and intended to produce optimally correlatable Nodes **180**, such Nodes **180** ideally capturing a Relation (value of Bond **184**) between the values of Subject **182** and Attribute **186**. The present invention sets no such standard for Node **180** creation, but instead, establishes Patterns **370** and Constraints **375** which can ultimately produce Notes **160** at machine speed.

The two methods of resource decomposition applied in current embodiments of the present invention are word classification and intermediate format. Word classification identifies words as instances of parts of speech (e.g. nouns, verbs, adjectives). Correct word classification often requires a text called a corpus because word classification is dependent upon not what a word is, but how it is used. Although the task of word classification is unique for each human language, all human languages can be decomposed into parts of speech. The human language decomposed by word classification in the preferred embodiment is the English language, and the means of word classification is a natural language parser (NLP) (e.g. GATE, a product of the University of Sheffield, UK). In one embodiment,

(a) text is input to the NLP;
(b) the NLP restructures the text into a "document of sentences";
(c) for each "sentence",
(c1) the NLP encodes a sequence of tokens, where each token is a code for the part of speech of the corresponding word in the sentence.

Where the resource contains at least one formatting, processing, or special character not permitted in plain text, the method is:

(a) text is input to the NLP;
(b) the NLP restructures the text into a "document of sentences";
(c) for each "sentence",
(c1) the NLP encodes a sequence of tokens, where each token is a code for the part of speech of the corresponding word in the sentence.
(c2) characters or words that contain characters not recognizable to the NLP are discarded from both the sentence and the sequence of tokens.

By using this second method, resources containing any English language text may be decomposed into nodes, including resources formatted as:

(i) text (plain text) files.
(ii) Rich Text Format (RTF) (a standard developed by Microsoft, Inc.). An alternative method is to first obtain clean text from RTF by the intermediate use of a RTF-to-text conversion utility (e.g. RTF-Parser-1.09, a product of Pete Sergeant).
(iii) Extended Markup Language (XML) (a project of the World Wide Web Consortium) files as described more immediately hereinafter.
(iv) any dialect of markup language files, including, but not limited to: HyperText Markup Language (HTML) and Extensible HyperText Markup Language (XHTML™) (projects of the World Wide Web Consortium), RuleML (a project of the RuleML Initiative), Standard Generalized Markup Language (SGML) (an international standard), and Extensible Stylesheet Language (XSL) (a project of the World Wide Web Consortium) as described more immediately hereinafter.
(v) Portable Document Format (PDF) (a proprietary format of Adobe, Inc.) files (by means of the intermediate use of a PDF-to-text conversion utility).
(vi) MS WORD files e.g. DOC files used to store documents by MS WORD (a word processing software product of Microsoft, Inc.) This embodiment programmatically utilizes a MS Word-to-text parser (e.g. the Apache POI project, a product of Apache.org). The POI project API also permits programmatically invoked text extraction from Microsoft Excel spreadsheet files (XLS). An MS Word file can also be processed by a NLP as a plain text file containing special characters, although XLS files can not.
(vii) event-information capture log files, including, but not limited to transaction logs, telephone call records, employee timesheets, and computer system event logs.
(viii) web pages
(ix) blog pages

For decomposition XML files by means of word classification, decomposition is applied only to the English language content enclosed by XML element opening and closing tags with the alternative being that decomposition is applied to the English language content enclosed by XML element opening

and closing tags, and any English language tag values of the XML element opening and closing tags. This embodiment is useful in cases of the present invention that seek to harvest metadata label values in conjunction with content and informally propagate those label values into the nodes composed from the element content. In the absence of this capability, this embodiment relies upon the XML file being processed by a NLP as a plain text file containing special characters. Any dialect of markup language files, including, but not limited to: HyperText Markup Language (HTML) and Extensible HyperText Markup Language (XHTML™) (projects of the World Wide Web Consortium), RuleML (a project of the RuleML Initiative), Standard Generalized Markup Language (SGML) (an international standard), and Extensible Stylesheet Language (XSL) (a project of the World Wide Web Consortium) is processed in essentially identical fashion by the referenced embodiment.

Email messages and email message attachments are decomposed using word classification in a preferred embodiment of the present invention. As described earlier, the same programmatically invoked utilities used to access and search email repositories on individual computers and servers are directed to the extraction of English language text from email message and email attachment files. Depending upon how "clean" the resulting extracted English language text can be made, the NLP used by the present invention will process the extracted text as plain text or plain text containing special characters. Email attachments are decomposed as described earlier for each respective file format.

Decomposition by means of word classification being only one of two methods for decomposition supported by the present invention, the other means of decomposition is decomposition of the information from a resource using an intermediate format. The intermediate format is a first term or phrase paired with a second term or phrase. In a preferred embodiment, the first term or phrase has a relation to the second term or phrase. That relation is either an implicit relation or an explicit relation, and the relation is defined by a context. In one embodiment, that context is a schema. In another embodiment, the context is a tree graph. In a third embodiment, that context is a directed graph (also called a digraph). In these embodiments, the context is supplied by the resource from which the pair of terms or phrases was extracted. In other embodiments, the context is supplied by an external resource. In accordance with one embodiment of the present invention, where the relation is an explicit relation defined by a context, that relation is named by that context.

In an example embodiment, the context is a schema, and the resource is a Relational Database (RDB). The relation from the first term or phrase to the second term or phrase is an implicit relation, and that implicit relation is defined in an RDB. The decomposition method supplies the relation with the pair of concepts or terms, thereby creating a node. The first term is a phrase, meaning that it has more than one part (e.g. two words, a word and a numeric value, three words), and the second term is a phrase, meaning that it has more than one part (e.g. two words, a word and a numeric value, three words).

The decomposition function takes as input the RDB schema. The method includes:

(A) A first phase, where

(a) the first term or phrase is the database name, and the second term or phrase is a database table name Example: database name is "ACCOUNTING", and database table name is "Invoice";

(b) The relation (e.g. "has") between the first term or phrase ("ACCOUNTING") and the second term or phrase ("Invoice") is recognized as implicit due to the semantics of the RDB schema;

(c) A node is produced ("Accounting-has-Invoice") by supplying the relation ("has") between the pair of concepts or terms;

(d) For each table in the RDB, the steps (a) fixed as the database name, (b) fixed as the relation, (c) where the individual table names are iteratively used, produce a node; and

(B) A second phase, where

(a) the first term or phrase is the database table name, and the second term or phrase is the database table column name. Example: database table name is "Invoice" and column name is "Amount Due";

(b) The relation (e.g. "has") between the first term or phrase ("Invoice") and the second term or phrase ("Amount Due") is recognized as implicit due to the semantics of the RDB schema;

(c) A node is produced ("Invoice-has-Amount Due") by supplying the relation ("has") between the pair of concepts or twills;

(d) For each column in the database table, the steps (a) fixed as the database table name, (b) fixed as the relation, (c) where the individual column names are iteratively used, produce a node;

(e) For each table in the RDB, step (d) is followed, with the steps (a) where the database table names are iteratively used, (b) fixed as the relation, (c) where the individual column names are iteratively used, produce a node;

In this embodiment, the entire schema of the RDB is decomposed, and because of the implicit relationship being immediately known by the semantics of the RDB, the entire schema of the RDB can be composed into nodes without additional processing of the intermediate format pair of concepts or terms.

In another embodiment, the decomposition function takes as input the RDB schema plus at least two values from a row in the table. The method includes

(a) the first term or phrase is a compound term, with

(b) the first part of the compound term being the database table column name which is the name of the "key" column of the table (for example for table "Invoice", the key column is "Invoice No"), and

(c) the second part of the compound term being the value for the key column from the first row of the table (for example, for the "Invoice" table column "Invoice No." the row 1 value of "Invoice No." is "500024", the row being called the "current row",

(d) the third part of the compound is the column name of a second column in the table (example "Status"),

(e) resulting in the first term or phrase being "Invoice No. 500024 Status";

(f) the second term or phrase is the value from second column, current row Example: second column name is "Status", value of row 1 is "Overdue";

(g) The relation (e.g. "is") between the first term or phrase ("Invoice No. 500024 Status") and the second term or phrase ("Overdue") is recognized as implicit due to the semantics of the RDB schema;

(h) A node is produced ("Invoice No. 500024 Status-is-Overdue") by supplying the relation ("is") between the pair of concepts or terms;

(i) For each row in the table, the steps (b) fixed as the key column name, (c) varying with each row, (d) fixed as name of second column, (f) varying with the value in the second column for each row, with (g) the fixed relation ("is"), produces a node (h);

(j) For each column in the table, step (i) is run;

(k) For each table in the database, step (j) is run;

The entire contents of the RDB can be decomposed, and because of the implicit relationship being immediately known by the semantics of the RDB, the entire contents of the RDB can be composed into nodes without additional processing of the intermediate format pair of terms or phrases.

Where the context is a tree graph, and the resource is a taxonomy, the relation from the first term or phrase to the second term or phrase is an implicit relation, and that implicit relation is defined in a taxonomy.

The decomposition function will capture all the hierarchical relations in the taxonomy. The decomposition method is a graph traversal function, meaning that the method will visit every vertex of the taxonomy graph. In a tree graph, a vertex (except for the root) can have only one parent, but many siblings and many children. The method includes:

(a) Starting from the root vertex of the graph,
(b) visit a vertex (called the current vertex);
(c) If a child vertex to the current vertex exists;
(d) The value of the child vertex is the first term or phrase (example "mammal");
(e) The value of the current vertex is the second term or phrase (example "living organism");
(f) The relation (e.g. "is") between the first term or phrase (child vertex value) and the second term or phrase (parent vertex value) is recognized as implicit due to the semantics of the taxonomy;
(g) A node is produced ("mammal-is-living organism") by supplying the relation ("is") between the pair of concepts or terms;
(h) For each vertex in the taxonomy graph, the steps of (b), (c), (d), (e), (f), (g) are executed;

The parent/child relations of entire taxonomy tree can be decomposed, and because of the implicit relationship being immediately known by the semantics of the taxonomy, the entire contents of the taxonomy can be composed into nodes without additional processing of the intermediate format pair of concepts or terms.

In another embodiment, the decomposition function will capture all the sibling relations in the taxonomy. The method includes:

(a) Starting from the root vertex of the graph,
(b) visit a vertex (called the current vertex);
(c) If more than one child vertex to the current vertex exists;
(d) using a left-to-right frame of reference;
(e) The value of the first child vertex is the first term or phrase (example "humans");
(f) The value of the closest sibling (proximal) vertex is the second term or phrase (example "apes");
(g) The relation (e.g. "related") between the first term or phrase (first child vertex value) and the second term or phrase (other child vertex value) is recognized as implicit due to the semantics (i.e. sibling relation) of the taxonomy;
(h) A node is produced ("humans-related-apes") by supplying the relation ("related") between the pair of concepts or terms;
(i) For each other child (beyond the first child) vertex of the current vertex, the steps of (e), (f), (g), (h) are executed;
(j) For each vertex in the taxonomy graph, the steps of (b), (c), (d), (i) are executed;

All sibling relations in the entire taxonomy tree can be decomposed, and because of the implicit relationship being immediately known by the semantics of the taxonomy, the entire contents of the taxonomy can be composed into nodes without additional processing of the intermediate format pair of terms or phrases.

Where the context is a digraph, and the resource is an ontology, the relation from the first term or phrase to the second term or phrase is an explicit relation, and that explicit relation is defined in an ontology.

The decomposition function will capture all the semantic relations of semantic degree 1 in the ontology. The decomposition method is a graph traversal function, meaning that the method will visit every vertex of the ontology graph. In an ontology graph, semantic relations of degree 1 are represented by all vertices exactly 1 link ("hop") removed from any given vertex. Each link must be labeled with the relation between the vertices. The method includes:

(a) Starting from the root vertex of the graph,
(b) visit a vertex (called the current vertex);
(c) If a link from the current vertex to another vertex exists;
(d) Using a clockwise frame of reference;
(e) The value of the current vertex is the first term or phrase (example "husband");
(f) The value of the first linked vertex is the second term or phrase (example "wife");
(g) The relation (e.g. "spouse") between the first term or phrase (current vertex value) and the second term or phrase (linked vertex value) is explicitly provided due to the semantics of the ontology;
(h) A node is produced ("husband-spouse-wife") (meaning formally that "there exists a husband who has a spouse relation with a wife") by supplying the relation ("spouse") between the pair of terms or phrases;
(i) For each vertex in the taxonomy graph, the steps of (b), (c), (d), (e), (f), (g), (h) are executed;

The degree one relations of entire ontology tree can be decomposed, and because of the explicit relationship being immediately known by the labeled relation semantics of the ontology, the entire contents of the ontology can be composed into nodes without additional processing of the intermediate format pair of terms or phrases.

A node is comprised of parts. The node parts can hold data types including, but not limited to text, numbers, mathematical symbols, logical symbols, URLs, URIs, and data objects. The node data structure is sufficient to independently convey meaning, and is able to independently convey meaning because the node data structure contains a relation. The relation manifest by the node is directional, meaning that the relationships between the relata may be uni-directional or bi-directional. A uni-directional relationship exists in only a single direction, allowing a traversal from one part to another but no traversal in the reverse direction. A bi-directional relationship allows traversal in both directions.

A node is a data structure comprised of three parts in one preferred embodiment, and the three parts contain the relation and two relata. The arrangement of the parts is:

(a) the first part contains the first relatum;
(b) the second part contains the relation;
(c) the third part contains the second relatum;

The naming of the parts is:

(a) the first part, containing the first relatum, is called the subject;
(b) the second part, containing the relation, is called the bond;
(c) the third part, containing the second relatum, is called the attribute;

In another preferred embodiment, a node is a data structure and is comprised of four parts. The four parts contain the relation, two relata, and a source. One of the four parts is a source, and the source contains a URL or URI identifying the resource from which the node was extracted. In an alternative embodiment, the source contains a URL or URI identifying

an external resource which provides a context for the relation contained in the node. In these embodiments, the four parts contain the relation, two relata, and a source, and the arrangement of the parts is:

(a) the first part contains the first relatum;
(b) the second part contains the relation;
(c) the third part contains the second relatum;
(d) the fourth part contains the source;

The naming of the parts is:

(a) the first part, containing the first relatum, is called the subject;
(b) the second part, containing the relation, is called the bond;
(c) the third part, containing the second relatum, is called the attribute;
(d) the fourth part, containing the source, is called the sequence;

The generation of nodes **180**A, **180**B is achieved using the products of decomposition by a natural language processor (NLP) **310**, including at least one sentence of words and a sequence of tokens where the sentence and the sequence must have a one-to-one correspondence **415**. All nodes **180**A, **180**B that match at least one syntactical pattern **370** can be constructed. The method is:

(a) A syntactical pattern **370** of tokens is selected (example: <noun><preposition><noun>);
(b) Moving from left to right;
(c) The sequence of tokens is searched for the center token (<preposition>) of the pattern;
(d) If the correct token (<preposition>) is located in the token sequence;
(e) The <preposition> token is called the current token;
(f) The token to the left of the current token (called the left token) is examined;
(g) If the left token does not match the pattern,
  a. the attempt is considered a failure;
  b. searching of the sequence of tokens is continued from the current token position;
  c. until a next matching <preposition> token is located;
  d. or the end of the sequence of tokens is encountered;
(h) if the left token does match the pattern,
(i) the token to the right of the current token (called the right token) is examined;
(j) If the right token does not match the pattern,
  a. the attempt is considered a failure;
  b. searching of the sequence of tokens is continued from the current token position;
  c. until a next matching <preposition> token is located;
  d. or the end of the sequence of tokens is encountered;
(k) if the right token matches the pattern,
(l) a node **180**A, **180**B is created;
(m) using the words from the word list that correspond to the <noun><preposition><noun> pattern, example "action regarding inflation";
(n) searching of the sequence of tokens is continued from the current token position;
(o) until a next matching <preposition> token is located;
(p) or the end of the sequence of tokens is encountered;

Steps (a)-(l) represent an example of a per pattern token seeking behavior constraint **375***n* of FIG. **3**.

The generation of nodes is achieved using the products of decomposition by a natural language processor (NLP), including at least one sentence of words and a sequence of tokens where the sentence and the sequence must have a one-to-one correspondence. All nodes that match at least one syntactical pattern can be constructed. The method is:

(q) A syntactical pattern of tokens is selected (example: <noun><preposition><noun>);
(r) Moving from left to right;
(s) The sequence of tokens is searched for the center token (<preposition>) of the pattern;
(t) If the correct token (<preposition>) is located in the token sequence;
(u) The <preposition> token is called the current token;
(v) The token to the left of the current token (called the left token) is examined;
(w) If the left token does not match the pattern,
  a. the attempt is considered a failure;
  b. searching of the sequence of tokens is continued from the current token position;
  c. until a next matching <preposition> token is located;
  d. or the end of the sequence of tokens is encountered;
(x) if the left token does match the pattern,
(y) the token to the right of the current token (called the right token) is examined;
(z) If the right token does not match the pattern,
  a. the attempt is considered a failure;
  b. searching of the sequence of tokens is continued from the current token position;
  c. until a next matching <preposition> token is located;
  d. or the end of the sequence of tokens is encountered;
(aa) if the right token matches the pattern,
(bb) a node is created;
(cc) using the words from the word list that correspond to the <noun><preposition><noun> pattern, example "prince among men";
(dd) searching of the sequence of tokens is continued from the current token position;
(ee) until a next matching <preposition> token is located;
(ff) or the end of the sequence of tokens is encountered;

Steps (r)-(bb) represent another example of a per pattern token seeking behavior constraint **375** of FIG. **3**.

The per pattern token seeking behavior constraints are not necessarily those normally associated with the semantic patterns of a language.

A preferred embodiment of the present invention is directed to the generation of nodes using all sentences which are products of decomposition of a resource. The method includes an inserted step (q) which executes steps (a) through (p) for all sentences generated by the decomposition function of an NLP.

Nodes can be constructed using more than one pattern. The method is:

(1) The inserted step (a1) is preparation of a list of patterns. Such a list of patterns is shown at item **370** of FIG. **3**. This list can start with two patterns and extend to essentially all patterns usable in making a node, and include but are not limited to:
  (i) <noun><verb><noun> example: "man bites dog",
  (ii) <noun><adverb><verb> example: "horse quickly runs",
  (iii) <verb><adjective><noun> example: "join big company",
  (iv) <adjective><noun><noun> example: "silent night song",
  (v) <noun><preposition><noun> example: "voters around country";
(2) The inserted step (p1) where steps (a) through (p) are executed for each pattern in the list of patterns;

In an improved approach, nodes are constructed using more than one pattern, and the method for constructing nodes uses a sorted list of patterns. In this embodiment,

The inserted step (a2) sorts the list of patterns by the center token, then left token then right token (example: <adjective> before <noun> before <preposition>), meaning that the search order for the set of patterns (i) through (v) would become (iii)(ii)(iv)(v)(i), and that patterns with the same center token would become a group.

(b)(c) Each sequence of tokens is searched for the first center token in the pattern list i.e. <adjective>

(d) If the correct token (<adjective>) is located in the token sequence;

(e) The located <adjective> token is called the current token;

(e1) Using the current token,

(e2) Each pattern in the list with the same center token (i.e. each member of the group in the pattern list) is compared to the right token, current token, and left token in the sequence at the point of the current token;

(e3) For each group in the search list, steps (b) through (e2) are executed;

(q) steps (b) through (e3) are executed for all sentences decomposed from the resource;

Additional interesting nodes can be extracted from a sequence of tokens using patterns of only two tokens. The method searches for the right token in the patterns, and the bond value of constructed nodes is supplied by the node constructor. In another variation, the bond value is determined by testing the singular or plural form of the subject (corresponding to the left token) value. In this embodiment,

(a) The pattern is <noun><adjective>;

(b) Moving from left to right;

(c) The sequence of tokens is searched for the token <adjective>;

(d) If the correct token (<adjective>) is located in the token sequence;

(e) The <adjective> token is called the current token;

(f) The token to the left of the current token (called the left token) is examined;

(g) If the left token does not match the pattern (<noun>),

a. the attempt is considered a failure;

b. searching of the sequence of tokens is continued from the current token position;

c. until a next matching <adjective> token is located;

d. or the end of the sequence of tokens is encountered;

(h) if the left token does match the pattern,

(i) a node is created;

(j) using the words from the word list that correspond to the <noun><adjective> pattern, example "mountain big";

(k) the subject value of the node (corresponding to the <noun> position in the pattern) is tested for singular or plural form

(l) a bond value for the node is inserted based upon the test (example "is" "are")

(m) resulting in the node "mountain is big"

(n) searching of the sequence of tokens is continued from the current token position;

(o) until a next matching <adjective> token is located;

(p) or the end of the sequence of tokens is encountered;

(q) steps (a) through (p) are executed for all sentences decomposed from the resource;

Using a specific pattern of three tokens, the method for constructing nodes searches for the left token in the patterns, the bond value of constructed nodes is supplied by the node constructor, and the bond value is determined by testing the singular or plural form of the subject (corresponding to the left token) value. In this embodiment,

(a) The pattern is <adjective><noun><noun>;

(b) Moving from left to right;

(c) The sequence of tokens is searched for the token <adjective>;

(d) If the correct token (<adjective>) is located in the token sequence;

(e) The <adjective> token is called the current token;

(f) The token to the right of the current token (called the center token) is examined;

(g) If the center token does not match the pattern (<noun>),

a. the attempt is considered a failure;

b. searching of the sequence of tokens is continued from the current token position;

c. until a next matching <adjective> token is located;

d. or the end of the sequence of tokens is encountered;

(h) if the center token does match the pattern,

(i) The token to the right of the center token (called the right token) is examined;

(j) If the right token does not match the pattern (<noun>),

a. the attempt is considered a failure;

b. searching of the sequence of tokens is continued from the current token position;

c. until a next matching <adjective> token is located;

d. or the end of the sequence of tokens is encountered;

(k) if the center token does match the pattern,

(l) a node is created;

(m) using the words from the word list that correspond to the <adjective><noun><noun> pattern, example "silent night song";

(n) the attribute value of the node (corresponding to the right token <noun> position in the pattern) is tested for singular or plural form

(o) a bond value for the node is inserted based upon the test (example "is" "are")

(p) resulting in the node "silent night is song"

(q) searching of the sequence of tokens is continued from the current token position;

(r) until a next matching <adjective> token is located;

(s) or the end of the sequence of tokens is encountered;

(t) steps (a) through (s) are executed for all sentences decomposed from the resource;

Nodes are constructed using patterns where the left token is promoted to a left pattern containing two or more tokens, the center token is promoted to a center pattern containing no more than two tokens, and the right token is promoted to a right pattern containing two or more tokens. By promoting left, center, and right tokens to patterns, more complex and sophisticated nodes can be generated. In this embodiment, the NLP's use of the token "TO" to represent the literal "to" can be exploited. For example,

(i) <adjective><noun> <verb> <adjective><noun> "large contributions fight world hunger",

(ii) <noun> <TO><verb> <noun> "legislature to consider bill",

(iii) <noun> <adverb><verb> <adjective><noun> "people quickly read local news"

For example, using <noun> <TO><verb> <noun> "legislature to consider bill",

(a) Separate lists of patterns for left pattern, center pattern, and right pattern are created and referenced;

(b) The leftmost token from the center pattern is used as the search

(c) If the correct token (<TO>) is located in the token sequence;

(d) The <TO> token is called the current token;

(e) The token to the right of the current token (called the right token in the context of the center patterns) is examined;
(f) If the token does not match any center pattern right token,
a. the attempt is considered a failure;
b. searching of the sequence of tokens is continued from the current token position;
c. until a next matching <TO> token is located;
d. or the end of the sequence of tokens is encountered;
(g) if the right token does match the pattern of the center pattern (<TO><verb>),
(h) the token to the left of the current token (called the right token in the context of the left patterns) is examined;
(i) If the right token does not match any left pattern right token,
a. the attempt is considered a failure;
b. searching of the sequence of tokens is continued from the current token position;
c. until a next matching <TO> token is located;
d. or the end of the sequence of tokens is encountered;
(j) if the right token matches the pattern,
(k) The token to the right of the current token (called the right token in the context of the center patterns) becomes the current token;
(l) The token to the right of the current token (called the left token in the context of the right patterns) is examined;
(m) If the token does not match any right pattern left token,
a. the attempt is considered a failure;
b. searching of the sequence of tokens is continued from the current token position;
c. until a next matching <TO> token is located;
d. or the end of the sequence of tokens is encountered;
(n) if the left token does match the pattern of the right pattern (<noun>),
(o) a node is created;
(p) using the words from the word list that correspond to the <noun> <TO><verb> <noun> "legislature to consider bill",
(q) searching of the sequence of tokens is continued from the current token position;
(r) until a next matching <preposition> token is located;
(s) or the end of the sequence of tokens is encountered.

Post Generation Node Filters

Under certain conditions, it is desirable to filter out certain possible node constructions. Those filters include, but are not limited to:

(i) All words in subject, bond, and attribute are capitalized;
(ii) Subject, bond, or attribute start or end with a hyphen or an apostrophe;
(iii) Subject, bond, or attribute have a hyphen plus space ("-") or space plus hyphen ("-") or hyphen plus hyphen ("-") embedded in any of their respective values;
(iv) Subject, bond, or attribute contain sequences greater than length three (3) of the same character (ex: "FFFF");
(v) Subject, bond, or attribute contain a multi-word value where the first word or the last word of the multi-word value is only a single character (ex: "a big");
(vi) Subject and attribute are singular or plural forms of each other;
(vii) Subject and attribute are identical or have each other's value embedded (ex: "dog" "sees" "big dog");
(viii) Subject, bond, or attribute respectively contain two identical words (ex: "Texas Texas" "is" "state");

Where the nodes are comprised of four parts, the fourth part contains a URL or URI of the resource from which the node was extracted. In this embodiment, in addition to the sentence (sequence of words and corresponding sequence of tokens), the URL or URI from which the sentence was extracted is passed to the node generation function. For every node created from the sentence by the node generation function, the URL or URI is loaded into the fourth part, called the Sequence **186**, of the node data structure.

Where the four part nodes are generated using the RDB decomposition function, the RDB decomposition function will place in the fourth (sequence) part of the node the URL or URI of the RDB resource from which the node was extracted, typically, the URL by which the RDB decomposition function itself created a connection to the database. An example using the Java language Enterprise version, using a well known RDBMS called MySQL and a database called "mydb":"jdbc:mysql://localhost/mydb". If the RDBMS is a Microsoft Access database, the URL might be the file path, for example: "c:\anydatabase.mdb". This embodiment is constrained to those RDBMS implementations where the URL for the RDB is accessible to the RDB decomposition function. Note that the URL of a database resource is usually not sufficient to programmatically access the resource.

FIG. **4** illustrates the operation of the node to note conversion function of FIG. **1** in accordance with one aspect of the invention. The Note Conversion Function **163** is simply illustrated in FIG. **4**. The products of the Decomposition Function **130** are Nodes **180**. An example Node **180** is given. The example Node **180** is composed of three parts. The first part of the example Node **180** is a Subject **182**, which contains the value "GOLD". The second part of the example Node **180** is a Bond **184**, which contains the value "IS". The third part of the example Node **180** is an Attribute **186**, which contains the value "STANDARD". The Note Conversion Function extracts the value from the Subject **182** ("GOLD"), converts it to text if the value is not already in text form, and places the text in the leftmost position of the Note **160**, which is, in this embodiment a text data object. The Note Conversion Program **163** then concatenates a space character to the current rightmost character of the Note **160** text value. The Note Conversion Function then extracts the value from the Bond **184** ("IS"), converts it to text if the value is not already in text form, and places the text in the leftmost position of the Note **160**. The Note Conversion Program **163** then concatenates a space character to the current rightmost character of the Note **160** text value. The Note Conversion Function then extracts the value from the Attribute **186** ("STANDARD"), converts it to text if the value is not already in text form, and places the text in the leftmost position of the Note **160**. The Conversion **163** of the Node **180** into a Note **160** is then complete, and the Note **160** is placed in the Note Container **168**.

FIG. **5** is a flow chart of the functionality of Note Taking Program **170**. In one embodiment, a User **305** clicks on the Notes Icon **410** to Start. The Note Taking Program **170** will first check that a Document **260** is displayed in the Program **270** e.g., an Internet Browser program. If a Document **260** is in fact displayed, the Note Taking Program **170** will invoke the Document Decomposition Function **130**. As is illustrated in FIG. **3**, the Decomposition Function **130** will create Nodes **180**, from which the Note Conversion Function **163** will create Notes **160**. Referring again to FIG. **5**, the Note Conversion Function **163** will then place in Memory **220** a Note Container **168** with all Notes **160** that have been created. The Note Taking Function **170** will fetch the Note Container **168** from Memory **220**, render a Note Selection Window **176** on the Display **210**, render the Controls **181** on the Display **210**, and populate the Note Selection Window **176** with Notes **160** rendered for display. Then the Note Taking Program **170** will enable all Controls **181** which bind to all Notes (as opposed to

Selected Notes). When the User **305** selects on of the enabled functions and activates the Control **181**, the Note Taking Program **170** executes the selected function and Ends. Alternately, if the User **305** selects Notes **160** from the Note Selection Window **176**, the Note Taking Program **170** will enable the Controls **181** that operate on selected Notes only. Alternatively, if there is no Document **260** displayed by the Program **270**, the Note Taking Program **270** will check the default directory on Hard Disk **190** for extant Note Container **168** files. If such files exist, the Note Taking Program will prompt the User **305** to select a Note Container **168** file. The Note Taking Program will retrieve the Note Container **168** from Hard Disk **190** and render the Note Selection Window **176**, the Controls **181**, and the Notes **160** on the Display **210** for further interactive interface with the User **305**.

FIG. **6** illustrates a software architecture preferable used for the computer generation of notes. FIG. **6** is a representation of how Documents **260**, whether residing on a Personal Computer **200**, in Personal Computer Memory **220**, on Personal Computer Hard Disk **190**, on Personal Computer Removable Media **250** or on a Network Server **350**, can be presented to a User **305** using the present invention. Also shown are the components of the Personal Computer **200** used in the process, including Main Memory **220**, Display **210**, Hard Disk **190**, and Removable Media Drive **250**. Finally, the use of Hard Disk **190** and Removable Media to permanently store (persist) the Notes **160** contained in the Note Container **168** is illustrated.

FIG. **7** is a block diagram of a hardware architecture of a personal computer used in carrying out the invention. FIG. **7** is an illustration of the internal components of a typical laptop or desktop personal computer **200**. Programs **270** and data are stored on Hard Disk **190** or Removable Media Drive **250**, and are placed into Main Memory **220** via the System Bus **230**. User interface and results are rendered on the Display **210**. Documents **260** may be stored on Hard Disk **190** or Removable Media read by a Removable Media Drive **250**, and placed in Main Memory where the Documents **260** and their content can be manipulated by Computer Program **270**, of which one embodiment of the present invention is an example, as is an Internet Browser such as Internet Explorer, a product of Microsoft, Inc.

FIG. **8** is a block diagram showing use of the note taking functionality in a networked environment. FIG. **8** is an illustration of a Personal Computer **200** connected to Network Servers **850**. The connections are through Communication Links **860**. The types of connections that can be made include connection via a Broadband Network **810**, which can directly connect to a Network Server **850** or can connect to a Network Server **850** through the Internet **840**. Alternatively, a Personal Computer **200** can be connected to a Network Server **850** via Wireless Access **820** to the Internet **840**. Also illustrated is connection of a Personal Computer **200** to a Network Server **850** via dial-up Modem **830** access to the Internet **840**. Documents **260** can be stored on a Network Server **850**. Upon request by a User **305** using a Software Program **270** operating on a Personal Computer **200**, Documents **260** can be retrieved from a Network Server **850** and transmitted over Communication Links **860** to the Personal Computer **200** for use in Software Program **270** such as that which is one embodiment of the present invention.

FIG. **9** is an illustration of an exemplary screen view of a notes selection window and related control buttons in accordance with one aspect of the invention.

A note selection window **176** is shown associated with two save buttons **181**A and **181**B. If it is desirable only to save certain notes from the note selection window, those notes will be selected, using, typically, standard operating system functionality followed by selection of the save selection button **181**A. When button **181**A is activated, the items that were identified for saving are stored on a hard disk, for example hard disk **190** using the save function **182** of FIG. **1**. If it is desirable to save all of the notes that have been generated, the save all button, **181**B can be selected.

In one embodiment, associated with FIG. **10**A, the Nodes **180**B generated by the Document Decomposition Function **130** are composed of four parts, the fourth part of such Nodes **180**B containing bibliographic information. With reference to FIG. 1C of Ser. No. 11/273,568,the fourth part of such Nodes **180**B is referred to as a Sequence or Source **188**. The type of bibliographic information that may be captured in the fourth part of such Nodes **180**B will vary depending upon the application programming interfaces (API) extent for each type of Document **260** and each type of Computer Program **270** used to display the Document **260**. At minimum, the bibliographic information captured in the fourth part of said Node **180**B will include the URL or URI of the Document **260**. In other embodiments, the title, author, publication date of the Document **260** may be captured in the fourth part of said Node **180**B. In further embodiments, the chapter, page, paragraph or line of the Document **260** where the text which served as the basis for creation of the Node **180**B will be captured in the fourth part of said Node **180**B. As previously described herein and in Ser. No. 11/273,568 and Ser. No. 11/314,835,Nodes **180** which are acquired from a Document **260** by the Document Decomposition Function **130** are not clipped or cut and pasted from the text of a Document **260**. Rather, Nodes **180** may be said to be associated with a location in the text of a Document **260**, that location being the location in the text corresponding to the location in the Sentence+ Token Sequence Pair **360** where the first token of a Pattern **370** was found by the Constraint **375** as it operated upon the Sentence+ Token Sequence Pair **360** and was successfully able to complete the generation of a Node **180**. Where the type of Document **260** and Computer Program **270** permit, that location will be captured in the fourth, Sequence **188** part of the Node **180**B. Referring to FIG. **10**A, note **160**B made from a four-part Node **180**B is composed of two parts, a Note Content part **161**, and a Note Source part **162**. In one embodiment, in addition to the Note Content **161**, the bibliographic material in the Note Source **162** also can be displayed in the Note Selection Window **176**, and subsequently printed or emailed.

As noted above, there is specific exception to the conformity of Notes **160** constructed by the current invention to notes constructed by hand and ad hoc by a human reviewer of the same Document **260**. That exception is for quotations—that is, text passages found in Documents **260** delimited by a single pair of complementary quotation marks.

In the case of quotations, where strictly accurate representation of a written or spoken text is required, one embodiment the current invention excludes quotations found in text from the default Tagger **340** algorithm. Instead, the Tagger **340** will, when encountering either an open or a close quotation marks character, utilize a created part of speech token, "QS" for a open quotation and "QT" for a closed quotation, to delimit the quotation in the Token Sequence. Subsequently, the Node Generation Function **380**, when processing the Sentence+ Token Sequence Pair **760** will use a special Constraint **375** when a "QS" token is encountered. The Constraint **375** will then seek the following complementary closed quotation mark "QT" token. All text referenced by tokens between the complementary quotation tokens is moved into a temporary memory buffer. If no closed quotation mark token is found, no

further special action will be taken by the Node Generation Function **380**. If a complementary closed quotation token is found, the Node Generation Function **380** will construct a two part Quotation Node **1010**, as shown in FIG. **10**B, the Quotation Node **1010** having a first part called the Quote **1013** and the Quotation Node **1010** having a second part called the Sequence or Source **1088**. The Quote **1013** part of the Quotation Node **1010** holds the entire quoted text and the Sequence **1088** part holding bibliographic information. For a Note **160**B made from a Quotation Node **1010**, the entire quoted text will be placed in the Note Content **161**, and the available bibliographic information will be placed in the Note Source **162**.

In another embodiment, the User **305** can elect to not respect quotations, in which case quoted text will be processed by the Tagger **340** and the Node Generation Function **380**, as is other text in the Document **260**. In one embodiment, the User **305**, can elect to respect quotations, but not to preserve quotations in Quotation Nodes **1010**. Using this method, when a open quotation token is encountered by the Node Generation Function **380** quotation token delimited words and tokens from the Sentence+ Token Sequence Pair **360** will be processed into Nodes **180** by the Node Generation Function **380** independently of the other words and tokens in the Sentence+Token Sequence Pair **360**.

While various embodiments of the present invention have been illustrated herein in detail, it should be apparent that modifications and adaptations to those embodiments may occur to those skilled in the art without departing from the scope of the present invention.

The invention claimed is:

1. A method for generating notes comprising:
- decomposing resources into a plurality of nodes so that each node comprises a data structure including a subject, an attribute, and a bond therebetween;
- storing the plurality of nodes in a node pool;
- constructing and storing correlations of linked together nodes of the node pool by at least iteratively adding nodes from the node pool onto an end of a chain of nodes by searching the node pool for a match between an attribute of a chained node and a subject of another unchained node in the node pool;
- converting the subject, the attribute, and the bond of each node in the node pool into textual objects;
- organizing the textual objects from a respective node into a textual phrase to define a note; and
- associating notes from each resource into a corresponding note set.

2. The method of claim **1** wherein the organizing comprises associating the subject of the respective node as a note text subject.

3. The method of claim **1** wherein the organizing comprises associating the bond of the respective node as a note text verb.

4. The method of claim **1** wherein the organizing comprises associating the attribute of the respective node as a note text object.

5. The method of claim **1** further comprising eliminating members from the node pool using post generation node filters.

6. The method of claim **1** wherein each node further comprises at least one of a source entry and a sequence entry.

7. The method of claim **1** wherein the node pool permits selection and retrieval using a hash map.

8. The method of claim **1** wherein the nodes are added to the chain of nodes until at least one of the following occurs:
- a user halts correlation;
- a set time expires;
- the chain of nodes comprises a number of nodes greater than a specified number;
- no further nodes in the node pool can be associated with the chain of nodes;
- a pre-selected term from a target node is added to the correlation; and
- a pre-selected target node is added to the correlation.

9. The method of claim **1** further comprising displaying notes defined from the node pool.

10. An apparatus for identifying knowledge comprising:
- an input device for permitting input; and
- a processor and memory associated therewith and coupled to said input device for
  - decomposing resources into a plurality of nodes so that each node comprises a data structure including a subject, an attribute, and a bond therebetween,
  - storing the plurality of nodes in a node pool,
  - constructing and storing correlations of linked together nodes of the node pool by at least iteratively adding nodes from the node pool onto an end of a chain of nodes by searching the node pool for a match between an attribute of a chained node and a subject of another unchained node in the node pool,
  - converting the subject, the attribute, and the bond of each node in the node pool into textual objects,
  - organizing the textual objects from a respective node into a textual phrase to define a note, and
  - associating notes from each resource into a corresponding note set.

11. The apparatus of claim **10** wherein the organizing comprises associating the subject of the respective node as a note text subject.

12. The apparatus of claim **10** wherein the organizing comprises associating the bond of the respective node as a note text verb.

13. The apparatus of claim **10** wherein the organizing comprises associating the attribute of the respective node as a note text object.

14. The apparatus of claim **10** wherein said processor and memory are for eliminating members from the node pool using post generation node filters.

15. The apparatus of claim **10** wherein each node further comprises at least one of a source entry and a sequence entry.

16. The apparatus of claim **10** wherein the node pool permits selection and retrieval using a hash map.

17. The apparatus of claim **10** wherein said processor and memory add the nodes to the chain of nodes until at least one of the following occurs:
- a user halts correlation;
- a set time expires;
- the chain of nodes comprises a number of nodes greater than a specified number;
- no further nodes in the node pool can be associated with the chain of nodes;
- a pre-selected term from a target node is added to the correlation; and
- a pre-selected target node is added to the correlation.

18. The apparatus of claim **10** wherein said processor and memory are for displaying notes defined from the node pool.

* * * * *